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METHOD AND APPARATUS FOR PURGING WATER FROM A WHIRLPOOL SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application ~~claims priority to~~ is a continuation-in-part of U.S. Patent Application Serial No. 09/544,157 filed April 6, 2000, now U.S. Pat. No. 6,279,177

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to whirlpools and spas, and, more particularly, to a method and apparatus for purging standing water from the water lines, fixtures, and jet manifolds during draining of the whirlpool or spa vessel.

BACKGROUND OF THE INVENTION

A whirlpool bath or spa typically includes a tub in which the water is circulated around the bather to provide a relaxing and therapeutic environment. Whirlpool baths generally accomplish this through the use of a hydraulic pump to circulate water from the interior of the bathtub through plumbing located on the exterior of the bathtub and back into the tub through a plurality of nozzles. Whirlpool baths can be commonly found in homes, health clubs, hospitals, and rehabilitation centers.

One concern currently receiving some attention regarding the safety of whirlpool baths relates to sanitation. Specifically, there is a concern

that it is difficult to completely drain all of the water from the whirlpool circulation plumbing, resulting in an environment conducive to the growth of bacteria and fungi. Since the plumbing is principally located outside of the bathtub (and is usually covered), the plumbing is generally inaccessible without undertaking the major effort of disassembling and removing the tub itself. The inaccessibility of the plumbing makes it nearly impossible to prevent standing water from being left therein after each use of the whirlpool bath. This is a problem because the standing water typically includes residual soap scum, scale deposits, sloughed off skin cells, body oils and other fluids, fecal matter, and other bathing residue. The plumbing therefore provides a dark, warm, and moist environment in which bacteria and fungi may thrive.

One recent study conducted by Dr. Rita Moyes of the Texas A&M University Department of Biology indicates that in addition to fungi, enteric organisms (Enterobacteriaceae), Pseudomonas sp., Legionella sp. (the causative agent of Legionnaire's disease and Pontiac fever) and Staphylococcus aureus may be found in such systems. "Microbial Loads in Whirlpool Bathtubs: An Emerging Health Risk", Moyes, unpublished report. According to Dr. Moyes, these bacteria cause 30-35% of all septicemias, more than 70% of all urinary tract infections, impetigo, folliculitis, and carbuncles and have been implicated in infections of the respiratory tract, burn wounds, ears, eyes, and intestines. Id. S. aureus is an etiological agent for bacteremia, endocarditis, pneumonia, empyema,

osteomyletis, and septic arthritis and also releases a toxin responsible for scalded skin syndrome, toxic shock syndrome, and food poisoning. Id.

One method known in the art of sanitizing a whirlpool bathtub is to drain and clean the circulation plumbing. However, complete draining of conventional whirlpools can only be accomplished through their disassembly. Alternately, sanitation of whirlpool plumbing has been attempted through the circulation of cleaning fluids therethrough, but this technique is largely ineffective without the use of expensive specialized equipment to heat, convey and concentrate special cleaning solutions therethrough. The simple addition of disinfectants or cleaning solutions to the water in the tub and the subsequent circulation of the water through the plumbing by actuation of the circulation pump has only a marginal effect on disinfecting the residual water left therein.

Obviously, it would be desirable to eliminate standing dirty water in whirlpool plumbing as a possible source of disease to the bather. The present invention is directed toward achieving this goal.

SUMMARY OF THE INVENTION

The present invention relates to a method and apparatus for purifying and removing standing water from the plumbing in a whirlpool bath. One form of the present invention is a pneumatic pump fluidically coupled to the pipes and nozzles of the hydraulic piping of a whirlpool bath and adapted to flush standing water out of the hydraulic plumbing after each use of the bath. An ozone source is fluidically connected to the pneumatic pump. The pneumatic plumbing is positioned substantially above the maximum water level allowed in the tub and substantially above the hydraulic plumbing and is connected in fluidic communication with different portions of the hydraulic plumbing, such that activation of the pneumatic pump after the tub has been substantially drained blows ozonated air through the hydraulic plumbing, purifying the residual water therein and forcing the purified water from the hydraulic plumbing. The ozonated air also disinfects the hydraulic plumbing.

One object of the present invention is to provide an improved whirlpool bath system. Related objects and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a first embodiment of a whirlpool bathtub fitted with a residual water purging system of the present invention.

FIG. 2 is an enlarged partial perspective view of a portion of the embodiment of FIG. 1.

FIG. 3 is a schematic view of the embodiment of FIG. 1.

FIG. 4 is a perspective view of a second embodiment of a whirlpool bathtub fitted with a residual water purging and purifying system of the present invention.

FIG. 5A is an enlarged partial perspective view of a portion of the embodiment of FIG. 4 with the ozone generator connected to the air pump inlet.

FIG. 5B is an enlarged partial perspective view of a portion of the embodiment of FIG. 4 with the ozone generator connected between the air manifold and the air pump.

FIG. 6 is a schematic view of the embodiment of FIG. 4.

FIG. 7 is a perspective cut-away view of a third embodiment of the present invention.

FIG. 8A is a perspective cut-away view of a fourth embodiment of the present invention.

FIG. 8B is a side partial sectional view of the embodiment of FIG. 8A.

FIG. 9A is a perspective cut-away view of a fifth embodiment of the present invention.

FIG. 9B is a side partial sectional view of the embodiment of FIG. 9A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, and alterations and modifications in the illustrated device, and further applications of the principles of the invention as illustrated therein are herein contemplated as would normally occur to one skilled in the art to which the invention relates.

FIGs. 1 and 2 illustrate one embodiment of the present invention, a system 10 for purging residual water from the whirlpool plumbing of a whirlpool bathtub. The water purging system 10 is adapted to use air pressure to blow residual or standing water from the water circulation plumbing used to generate the "whirlpool" effect in a whirlpool bathtub 20. The whirlpool bathtub 20 typically includes a water inlet 22 and a water outlet or drain 24 connected to a central plumbing system. The whirlpool bathtub 20 preferably includes an auxiliary water outlet/drain 26 positioned substantially above the water drain 24. (As used herein, "above" means positioned farther away in a direction opposite the pull of gravity; a first object positioned "above" a second object of identical mass would have more gravitational potential energy and would have farther to fall before reaching a common gravitational source.) The auxiliary drain 26 functions to prevent an overflow of the bathtub 20, and effectively

defines a maximum water level. However, the bathtub 20 may alternately include a single water drain 24 without an auxiliary drain 26.

A typical whirlpool bathtub 20 also includes a water pump 30 having a water pump inlet 32 and a water pump outlet 34. The water pump outlet 34 is connected in hydraulic communication with a whirlpool hydraulic system of plumbing 36 and is adapted to pump water therethrough when actuated while the bathtub 20 is filled with water.

The whirlpool hydraulic system 36 typically includes at least one suction fitting 38 formed through the bathtub 20. A suction conduit 40 extends from the suction fitting 38 to the water pump inlet 32, connecting the suction fitting 38 (and therethrough the bathtub 20) in hydraulic communication to the water pump 30. A plurality of water inlet or water jet nozzles 44 are also typically formed in the bathtub 20. A water manifold 46 is typically positioned around the bathtub 20 and is preferably positioned above the water level defined by the auxiliary drain 26. The water manifold 46 is connected in hydraulic communication to the plurality of water jet nozzles 44 by a plurality of water delivery conduits 48, each adapted to convey water from the water manifold 46 through the respective water jets 44 and into the bathtub 20. The water manifold 46 is also connected to the water pump outlet 34 by a water manifold conduit 49 extending therebetween in hydraulic communication. When actuated, the water pump 30 is adapted to receive water from the bathtub 20 through the suction fitting 38 and suction conduit 40 and return water under

pressure into the bathtub 20 through the jet nozzles 44 by way of the water manifold 46.

The water purging system 10 of the present invention includes an air pump 50 having an air pump inlet 51 and an air pump outlet 52. The air pump outlet 52 is connected in pneumatic communication to an air manifold 54 through an air delivery conduit 56 extending therebetween. The air manifold 54 preferably extends around the bathtub 20 and is more preferably positioned above the water manifold 46. A plurality of air nozzle conduits 58 extend from the air manifold 54 to each respective water jet nozzle 44, connecting the air manifold 54 thereto in pneumatic communication. Preferably, an air suction fitting conduit 60 extends from the air manifold 54 to the suction fitting 38, connecting the air manifold 54 in pneumatic communication to the suction fitting 38. More preferably, an air suction conduit conduit 62, and air water manifold conduit 64 and an air water pump outlet conduit 66 extend between the air manifold 54 and the suction conduit 40, the water manifold 46, and the water pump outlet 34, respectively, connecting the air manifold 54 in pneumatic communication thereto. Still more preferably, the air manifold 54 is connected to the hydraulic plumbing system 36 through valves 70 (preferably check valves) adapted to allow air to flow into the hydraulic plumbing system 36 and to prevent water from flowing from the hydraulic plumbing system 36 into the air manifold 54. However, the air pump 50 may be coupled to the hydraulic plumbing system 36 in any convenient configuration that provides air pressure to the hydraulic plumbing system

36 sufficient to blow any standing water left in the hydraulic plumbing system 36 into the whirlpool bathtub 20 where it can be drained.

FIG. 3 schematically illustrates the whirlpool water purging system 10 of the present invention in greater detail. The air pump 50 is connected to the air manifold 54 through the air delivery conduit 56. The air manifold 54 is connected to one or more of the various components of the whirlpool hydraulic plumbing circuit 36 (including the suction fitting(s) 38, the suction conduit 40, the water jet nozzles 44, the water manifold 46, and/or the water manifold conduit 49) through one or more air conduits 58, 60, 62, 64 and 66. An electronic controller 75 may be operationally coupled to the air pump 50 to facilitate automatic or manual actuation thereof. For example, a sensor 77 may be positioned in the bathtub 20 and adapted to send a signal to the electronic controller when the bathtub 20 is drained or when the water temperature passes a predetermined threshold. Upon receipt of the signal, the electronic controller 75 activates the air pump 50 for a predetermined length of time. Alternately, a sensor 77 may be positioned in whirlpool hydraulic plumbing circuit 36 and adapted to send a signal to the electronic controller 75 in the presence of a predetermined amount of moisture. Upon receipt and for the duration of the signal, the electronic controller 75 actuates the air pump 50 to supply a stream of pressurized air flowing through the whirlpool hydraulic plumbing system 36.

The electronic controller 75 may also be operationally connected to a heater 80. The heater 80 is preferably positioned so as to be operationally

coupled to the air pump 50, and is adapted to provide sufficient heat output to substantially heat the air flowing through the air pump 50 and through the air manifold 54, such that warm, dry air is provided to the whirlpool hydraulic plumbing system 36. The heater 80 may be slaved to the air pump 50 such that the heater 80 heats the air flowing through the air pump 50 whenever the air pump 50 is running. Alternately, the heater 80 may be independently controlled.

The electronic controller 75 may also be operationally coupled to any or all of the check valves 70, such that each of the check valves 70 may be independently operated. Independent operation of the check valves 70 allows the output of the air pump 50 to be concentrated as desired in the whirlpool hydraulic system 36. For example, while the bathtub 20 is filled with water, the check valves 70 connecting the air manifold 54 to the water inlet jets 44 may be opened and the remaining valves 70 may be closed, to concentrate the air flow through the water inlet jets 44. When the bathtub is drained, all of the check valves 70 may be opened to facilitate the rapid purging of water from the whirlpool hydraulic plumbing system 36. In one contemplated embodiment, a series of moisture sensors 77 may be positioned throughout the whirlpool hydraulic plumbing system 36 and operationally coupled to an electronic controller 75, such that the check valves 70 may be opened and closed to concentrate air flow through those portions of the hydraulic plumbing system 36 still containing moisture. In other words, the check valves 70 may be manipulated to maximize drying efficiency.

In operation, the water purging system 10 of the present invention supplies air pressure to the whirlpool hydraulic plumbing system 36 sufficient to purge remaining standing water left in the whirlpool hydraulic plumbing system 36. If the bathtub 20 is filled with water, actuation of the air pump 50 supplies pressurized air that may be used to aerate the water flowing through the water jet nozzles 44. When the water is substantially drained from the bathtub 20 and the whirlpool hydraulic plumbing system, actuation of the air pump 50 supplies pressurized air that may be directed through the whirlpool hydraulic plumbing system 36 to force substantially all of the residual water out of the hydraulic plumbing system 36. The air pump 50 may further be used to air dry the hydraulic plumbing system 36 by circulating a stream of pressurized air therethrough until the hydraulic plumbing system 36 is substantially dry. The effectiveness of the air-drying process may be enhanced by circulating heated air through the whirlpool hydraulic plumbing system 36.

The water purging system 10 of the present invention may be retrofitted to existing whirlpool hydraulic plumbing systems 36, or may be included therewith as part of a new whirlpool bathtub 20.

Another embodiment of the present invention is illustrated in FIGs. 4-6. FIGs. 4, 5A and 5B illustrate a water purging system 10A nearly identical to the one described above, with the addition of an ozone source 100A operationally connected to the air pump 50A. The ozone source 100A is preferably an ozone generator, but may also be an ozone tank or the

like. The ozone generator 100A supplies ozonated air to the air pump 50A for circulation throughout the air manifold 54A, the air conduits 56A, 58A, and the hydraulic system 36A, including the water jet bodies 44A during the water purge operation. The ozone generator 100A may be pneumatically connected to the air pump inlet 51A (see FIG. 5A), or may be pneumatically connected upstream from the air pump 50A (see FIG. 5B), to provide ozone to all of the air flowing through the hydraulic plumbing system 36A and the water jet bodies 44A. The ozone generator 100A may therefore pneumatically communicate ozone to the air entering the air manifold 54A for redistribution throughout the rest of the water purging system 10A. Alternately, individual ozone generators 100A may be connected upstream and adjacent each water jet body 44A to further purify the air, water, and/or air/water mixture being expelled therefrom. These may be added in addition to or in place of the ozone generator 100A pneumatically connected to the air pump 50A discussed above. Preferably, the ozone generator 100A is connected to the electronic controller 75A, such that the ozone generator 100A may be actuated by the electronic controller 75A upon receipt of a signal from an operator or from a sensor 77A (for example, a water level sensor indicating that the tub 20A has been recently drained.) The ozone generator 100A may thus be actuated for a predetermined period of time (such as, for example, for the duration of the purging operation) by the electronic controller 75A.

Ozone is a well-known oxidant and disinfectant, and is commercially used in water purification and waste treatment facilities.

The presence of ozone in the purging air helps to disinfect the air and water plumbing during the air purging operation. Further, the presence of ozone in the purging air also disinfects the air itself, reducing or eliminating airborne bacteria resulting from the air purging operation. Moreover, the interior of the tub may be shaped to direct the flow of ozonated water/air from the water jet bodies over the surface of the tub, to further disinfect the tub during/after use. Ozone may be injected into the air exclusively during the purging cycle, or at all times the air pump 50A is energized, since ozone is relatively harmless to people and in fact helps purify the water recirculated in the whirlpool bathtub 20A. Preferably, the ozone is introduced to the water purging system 10A upstream of the water jet bodies 44A. More preferably, ozone is introduced into the water purging system 10A upstream of the hydraulic plumbing system 36A.

Techniques for the generation of ozone are well known, any one of which may be utilized for the present ozone generator 100A. One commonly used technique is to irradiate oxygen molecules with very short wavelength high-energy ultraviolet (UV) radiation to cleave the oxygen molecules (O_2), producing lone ionized oxygen atoms (O), which combine with other O_2 molecules to form ozone molecules (O_3). Another technique for producing ozone is to expose O_2 molecules to a high-energy electromagnetic field, such as a brush discharge, to cleave the O_2 molecules for O_3 production. Heating the air to impart more energy to the O_2 molecules increases the efficiency of ozone production independent of the ozone production method chosen. One commercially available device,

the HYDRAZONE™ ozone generator, available from HYDRABATHS® of 211 S. Fairview Street, Santa Ana, California, combines the application of high-energy UV radiation with a high-energy electromagnetic field to efficiently produce ozone.

FIG. 7 illustrates still another embodiment of the present invention, a bathtub 20B having a hydraulic plumbing circuit 36B for circulating water therein and a pneumatic circuit 90B for bubbling air through water in the bathtub 20B. Hydraulic plumbing circuit 36B includes a water pump 30B connected in hydraulic communication (preferably through a water manifold 46B) with one or more jet bodies 44B to circulate water in the bathtub 20B. The water pump is also hydraulically connected to a suction inlet fitting 38B, such that water is transported from the bathtub 20B and recirculated thereinto by the water pump 36B through the jet bodies 44B.

The pneumatic circuit 90B includes a pneumatic pump or air blower 50B connected in pneumatic communication (preferably through an air manifold 54B) with a plurality of air jet bodies 92B positioned to open into or near the bottom of the bathtub 20B to bubble air through water contained therein. The air jet bodies 92B preferably include check valves to retard penetration of water thereinto. The pneumatic circuit 90B also includes an ozone generator 100B connected in pneumatic communication with the air blower 50B. The pneumatic circuit 90B further includes a pneumatic connection 94B between at least one element of the pneumatic circuit 90B, such as the air manifold 54B) and an element of the hydraulic

circuit 36B (for instance, the water manifold 46B). The pneumatic connection 94B preferably includes a check valve to minimize water incursion into the pneumatic circuit 90B; likewise, the pneumatic circuit 90B is preferably substantially positioned above the hydraulic circuit 36B for the same reason).

When the bathtub 20B contains water, the hydraulic circuit 36B may be selectively activated to circulate water. Likewise, the pneumatic circuit 90B may be activated to bubble ozonated air through the water. Alternately, both circuits 46B, 90B may be simultaneously activated to circulate the water while ozonated air is bubbled therethrough. The passage of ozonated air through the pneumatic and hydraulic circuits 90B, 36B, the water in the bathtub 20B and over the surface of the bathtub 20B purifies and disinfects the air, water, and surfaces with which the ozone comes into contact.

FIGs. 8A, 8B, 9A, and 9B illustrate yet another embodiment of the present invention, a bathtub 20C having a pneumatic circuit 90C for bubbling air through water in the bathtub 20C. The pneumatic circuit 90C includes a pneumatic pump or air blower 50C connected in pneumatic communication (preferably through an air manifold 54C) with a plurality of air inlets, such as air jets 92C (see FIG.s 9A and 9B) or air holes 93C (see FIGs. 8A and 8B) positioned to open into or near the bottom of the bathtub 20C to bubble air through water contained therein. The air jets/holes 92C/93C preferably include check valves to retard penetration of water therethrough and into the air manifold 54C. The pneumatic circuit

90C also includes an ozone generator 100C connected in pneumatic communication with the air blower 50C.

The bathtub 20C also includes a hydraulic circuit 36C for filling the bathtub 20c with water and circulating water in the bathtub 20C. In this embodiment, the hydraulic circuit 36C includes a faucet 96C and a drain 98C. When the bathtub 20C contains water, the pneumatic circuit 90C may be activated to bubble ozonated air through the water. The passage of ozonated air through the pneumatic circuits 90C, through the water in the bathtub 20C and over the surface of the bathtub 20C purifies and disinfects the air, water, and surfaces with which the ozone comes into contact.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.